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ABSTRACT

Examined in three studies were the influence of perceptual organization on children's memory and the relationship between operational thought and memory performance. In the first study, 72 children at 5, 7, and 9 years of age were given a series of Piagetian tasks and a memory task. Subjects were presented with 10 color-shape pairs depicted in either a unitary or a disjunctive fashion and were asked to recall which color went with which shape. No significant differences between unitary and disjunctive conditions and no significant relationships between cognitive tasks and memory performance were found. A second and a third study more closely examined the effects of subjects' actions on memory. The second study required children to draw unitary or disjunctive stimulus materials. Findings revealed that children remembered significantly more color-shape pairs in the unitary condition at every age level. Additional analyses suggested that the act of drawing specifically highlighted the integrative aspects of the unitary materials, particularly for the 7-year-olds. A third study required subjects to construct replicas of the stimuli. Results suggest that the act of construction facilitated memory and increased subjects' capacity to remember pairs in the disjunctive condition. (RH)

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Perceptual organization and operative thought:

A study of coherence in memory.

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The unified quality of perceived experience is among the most intriguing questions in philosophical and psychological discussions. The physiology of the receptor surface of the eye, as well as the early structural accounts of perceived experience as an amalgam of associated sensations, are testament to the possibility of a totally fragmented, perpetually changing perceptual experience. Yet we do not perceive a kalidoscopic world; instead, reality appears constant, organized and knowable. Describing what constitutes the nature of unified experience seems to be a hopelessly ephemeral task.

Historically, von Ehrenfels revolutionized the problem of unified perception by noting the distinctive qualities of perceptual wholes that exist independent of their particular elements. The often quoted example of a melody that can be recognized despite a transposition that changes every individual note provides a powerful demonstration of Gestalt qualities. The Berlin school of Gestalt Psychology elucidated the implications of von Ehrenfels' discovery by suggesting that the perceived configurations are not a result of the synthesis of distinct sensations but rather, that such organizational qualities are an a priori fact produced automatically and are as much physiological as they are psychological in nature. There are ample demonstrations of how such a priori organizational principles unify perceived experience and the writings of Kohler, Wertheimer and Duncker have extended this position to embrace the nature of thought itself.

A specific example of extending a description of the principles of perceptual organization to memory can be seen in the work of Asch, Ceraso and

Heimer (1960). Subjects were shown a series of cards depicting various colors and shapes. In one condition the colors and shapes were depicted in a unitary fashion, i.e., the subjects were presented with colored shapes (see Figure 1), and in a second condition the colors and shapes were presented in a disjunctive fashion, i.e., color and shape were separated on each card (see Figure 1). In a variety of memory tasks it was found that unitary stimuli were more accurately remembered than were the disjunctive stimuli. In both conditions the subjects saw essentially the same color-shape pairs but the important difference was in the organization of these elements. In the unitary condition color and shape were co-extensive in space and co-temporaneous during perception; whereas, in the disjunctive condition color and shape occupied distinct spatial dimensions and required distinct acts of perception. The perceptual organization of the stimulus materials seems critical in affecting memory.

While readily admitting to the importance of recognizing the wholeness of perceptual and intellectual organizations, Piaget has rejected the combination of the functions and structures of intelligence to the laws of perceptual organization (1960, p.60-68). First, Piaget finds such a position ... theoretically untenable in that it is merely descriptive of wholeness and "... sensory processing fades into pure receptivity, and abdicates in favor of the passivity of automatic mechanisms (p.64)." Secondly, Piaget rejects the nativism implied in positing a priori laws of organization. Such a position is inconsistent with his empirical findings demonstrating developmental changes in the perception of such organizational qualities as size constancy (also see Piaget, 1969, p.206-244). Parenthetically, it is interesting to note that these same objections can be raised against more recent empirical accounts of perceptual organization and intelligence such as the position suggested by Gibson (1983).

For Piaget the problem of perceiving and knowing unified experience is a matter of explaining the genesis of a system of relations. Each relation becomes a whole in itself that can be transformed into yet another system of relations. Thus, no organization can be described in absolute terms, nor can it be decomposed into its essential components. Understanding the establishment of these relations requires, for Piaget, serious consideration of the nature of constructive activity. In Piaget's (1969) studies of perception he examined not the characteristics of perceptual organization but the nature of perceptual activity and how young children "center" or are held by the dominant aspects of the perceptual field. But further, Piaget focuses on the way in which children become liberated from field effects and how perceptual activity is transformed into a system of intellectual activity. This transformation enables the child not only to respond to perceptual organization but also to regulate and mentally act on visual materials.

Elkind (1975; Elkind, Koegler & Go, 1964) has extended Piaget's account of perceptual activity in his studies of children's perception of part-whole relationships. Children between the ages of 4 and 8 years of age were shown a series of pictures depicting various objects in part-whole relationships, e.g., a person made out of fruit or a bicycle made out of candy canes, and were asked to report what they saw. The findings showed that the youngest children reported seeing various parts of the pictures but not the figural wholes; the 5 and 6 year olds tended to report just the the whole patterns ; and only the oldest children reported the integrative parts in whole configurations. Elkind points out that it is no coincident that these developmental changes in perception correspond to the onset of operational abilities. In a later study Elkind (Elkind, Anagnostopoulou

and Malone, 1970) found that children who spontaneously report integrative part-whole configurations were more likely to reconstruct the configurations from memory and were capable of performing logical operations on classes of objects. The present studies are an attempt to look more closely at the influence of perceptual organization on children's momory and to examine the relationship between developmental changes in the children's ability to perform certain logical tasks.

Experiment 1

In this first study 72 children ages 5, 7 and 9 participated. In a preliminary session the children were given a series of Piagetian tasks which included conservation of number and length problems, a classification task and class inclusion problems. In a second session the children were given the memory task taken from Asch,Ceraso and Heimer (1960). Half of the children at each age were presented with 10 color-shape pairs depicted in a unitary fashion and were asked to try to remember which color went with which shape. The remaining half of the children at each age were presented with the same color-shape pairs presented in a disjunctive fashion . Following the presentation of the stimulus materials the children were asked to try and match the various shapes with their appropriate colors.

The mean number of correctly matched shapes and colors are presented in Table 1 by age and condition. Analysis revealed a main effect for age ($F(2,66) = 4.28$, $p < .05$) and condition ($F(1,66) = 5.66$, $p < .05$) but no significant interaction. Post hoc comparisons indicated that the 9 year olds matched significantly more pairs than the 5 year olds; but pairwise comparisons between the unitary

and disjunctive conditions revealed no significant differences at any of the three age levels.

In order to examine the relationship between operational thought and memory a series of contingency tables were calculated for each age group between the children's performance on the cognitive tasks and their performance on the memory task. The children's success or failure on the cognitive tasks were compared to whether their performance on the memory task was above or below the mean score for their specific condition. No significant relationships were found between the cognitive tasks and the number of color-shape pairs that were remembered at any of the three age levels for either the unitary or disjunctive conditions.

It appears from these findings that the organizational properties of the stimulus materials do not effect children's memory. In accord with Piaget's critique of Gestalt Theory, the laws of perceptual organization do not directly map on to cognitive functions. It would seem that the finding of Asch, et. al. (1960), demonstrating the facilitating effect of unitary presentation among adults is not so much a result of the organizational characteristics of the materials as it is an achievement of the subjects to establish unitary relationships. The present findings demonstrate that children do not spontaneously establish such relationships.

However, these findings are also problematic for a Piagetian interpretation, at least as it is presented by Elkind. The children's ability to establish and benefit from unitary relationships did not parallel the onset of certain concrete operational skills. It has been fashionable for some

time now to question the explanatory value of cognitive stage or logico-mathematical structures. For example, Markman (1978) has shown that children's ability to understand part-whole relationships and answer class inclusion questions vary depending on the characteristics of the materials and their spatial proximity (also see Klahr & Wallace, 1972). Piaget himself has recognized that cognitive structure "...is a theoretical construct, not an empirical given (1970, p.98) " and recent work by Karmiloff-Smith (1979) questions the description of thought in terms of gross macro-developmental differences in logical abilities. Her studies of the micro-developmental changes in children's use of representational systems in memory tasks reveal the importance of considering specific action in characterizing cognitive functions. This second study is an attempt to more closely examine the effects of children's actions on memory for materials in differing perceptual organizations.

Experiment 2

Seventy-two children, the same ages as those in experiment 1, participated in this study. Each child was assigned to either a unitary or disjunctive condition and was presented with the same color-shape pairs as those used in experiment 1. However, while each card was presented the children were asked to draw what they saw using index cards and crayons that were provided. Children in the unitary condition drew each shape in its respective color and the children in the disjunctive condition drew each shape in black and added a patch of the appropriate color beneath it. While drawing, the children were reminded to try to remember which shape went with which color. When all ten color-shape pairs were presented and drawn, the

children were asked to match each shape with its color.

The mean number of correctly matched colors and shapes are presented in Table 2 by age and condition. Analysis revealed significant main effects for age ($F(2,66) = 4.97$, $p < .05$) and condition ($F(1,66) = 40.40$, $p < .01$). Post hoc comparisons showed that there was a general improvement in performance between the ages of 5 and 7 years in both conditions ($p < .05$); but most importantly the children remembered significantly more color-shape pairs in the unitary condition at every age level ($p < .05$). It seems that the act of drawing the stimulus materials highlighted the characteristics of their specific-perceptual organization, and contrary to the findings in the first study, affected the children's memory.

In order to determine the specific effects of drawing, i.e., whether drawing highlights the integrative aspects of the unitary organization or whether drawing emphasizes the separateness of the disjunctive organization, the data from this study were compared to the data from the first study. Analysis of the correctly remembered color-shape pairs from the disjunctive condition from the first and second study revealed no significant main effects or interaction. Analysis of the number of correctly remembered pairs from both unitary conditions, however, revealed significant effects for age ($F(2,66) = 5.95$, $p < .05$) and condition ($F(1,66) = 8.44$, $p < .01$) and no interaction. Post hoc comparisons indicated that for the 7 year old children drawing the color-shape pairs significanly increased the accuracy of their memory. It appears that the act of drawing specifically highlights the integrative aspects of the unitary materials, particularly for the 7 year olds. In considering the nature of the materials and the act of drawing this finding

makes sense. The unitary color-shape pairs are co-extensive in space and co-temporaneous. Reconstructing such configurations involve one coordinated act of drawing. The disjunctive pairs are spatially separate on the cards and involve two distinct acts of drawing, one for shape and one for color. It seems reasonable that such differences would affect memory. The important implication of this interpretation is that the nature of action determines the psychological consequences of the perceived physical properties and the quality of their organization. Different actions should therefore produce different effects. In a third study we attempted to further demonstrate the effects of distinctive action on perceptual organization.

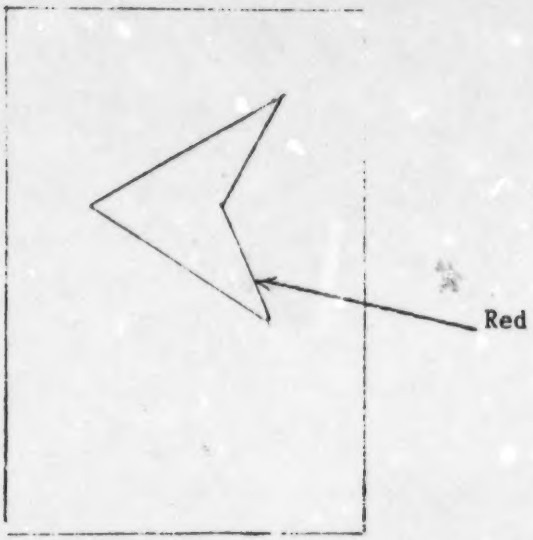
Experiment 3

In this third study seventy-two children ages 5, 7 and 9 were assigned to either a unitary or disjunctive condition as in the first and second studies. However, during the presentation of each card the children were asked to reconstruct a replica of the card they were looking at. Each replica was vertically cut in half (see Figure 2). The pieces were placed in front of the children face down. When each stimulus card was presented the children were instructed to turn the pieces over and put them together so they looked like the card in front of them. The children were then reminded to try to remember which shape went with which color. After the presentation of all ten cards the children were asked to match the shapes with their appropriate colors.

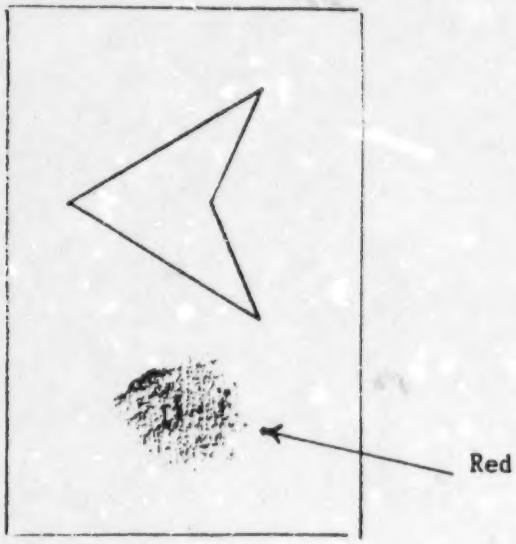
The mean number of correctly matched color-shape pairs are presented in Table 3 by age and condition. Analysis revealed main effects for age ($F(2,66) = 25.53$, $p < .01$) but no significant main effect for condition, nor was there

any interaction. Post hoc comparisons showed a significant increase in the number of accurately matched pairs between each age level ($p < .05$). It appears that the act of reconstructing a replica eliminated the pronounced effect between the unitary and disjunctive conditions that was found when the children were asked to draw the stimulus materials. In this respect these findings are similar to the results of the first study in which the children only perceived the color-shape pairs. However, an analysis comparing the data from the unitary condition from the first study with the data from the unitary condition in this study revealed a significant main effect for age ($F(2,66) = 9.93$, $p < .05$) and for the way in which the children acted on the stimulus materials ($F(1,66) = 10.80$, $p < .05$) and no significant interaction. Post hoc comparisons showed that at every age, the children who reconstructed the cards correctly matched more color-shape pairs than did the children who only perceived the same stimulus materials. It appears from this last study that the act of reconstructing the color-shape pairs by way of a simple puzzle, overall, facilitated the children's memory. But in addition, the act of reconstruction seems to have increased the children's capacity to integrate and remember the color shape pairs in the disjunctive condition.

It has been suggested that an understanding of part-whole relationships and the nature of psychological units in perception and memory require more than a description of the formal properties of materials, and more than a general characterization of children's thought processes. In these studies, differences in memory could not adequately be explained by the organizational properties of the color-shape pairs, nor could they be explained by differences in age or cognitive abilities. Instead these studies have underscored the importance of considering the integration that is achieved through very specific types of action.



Unitary Stimulus



Disjunctive Stimulus

Figure 1. Unitary and Disjunctive Stimuli.

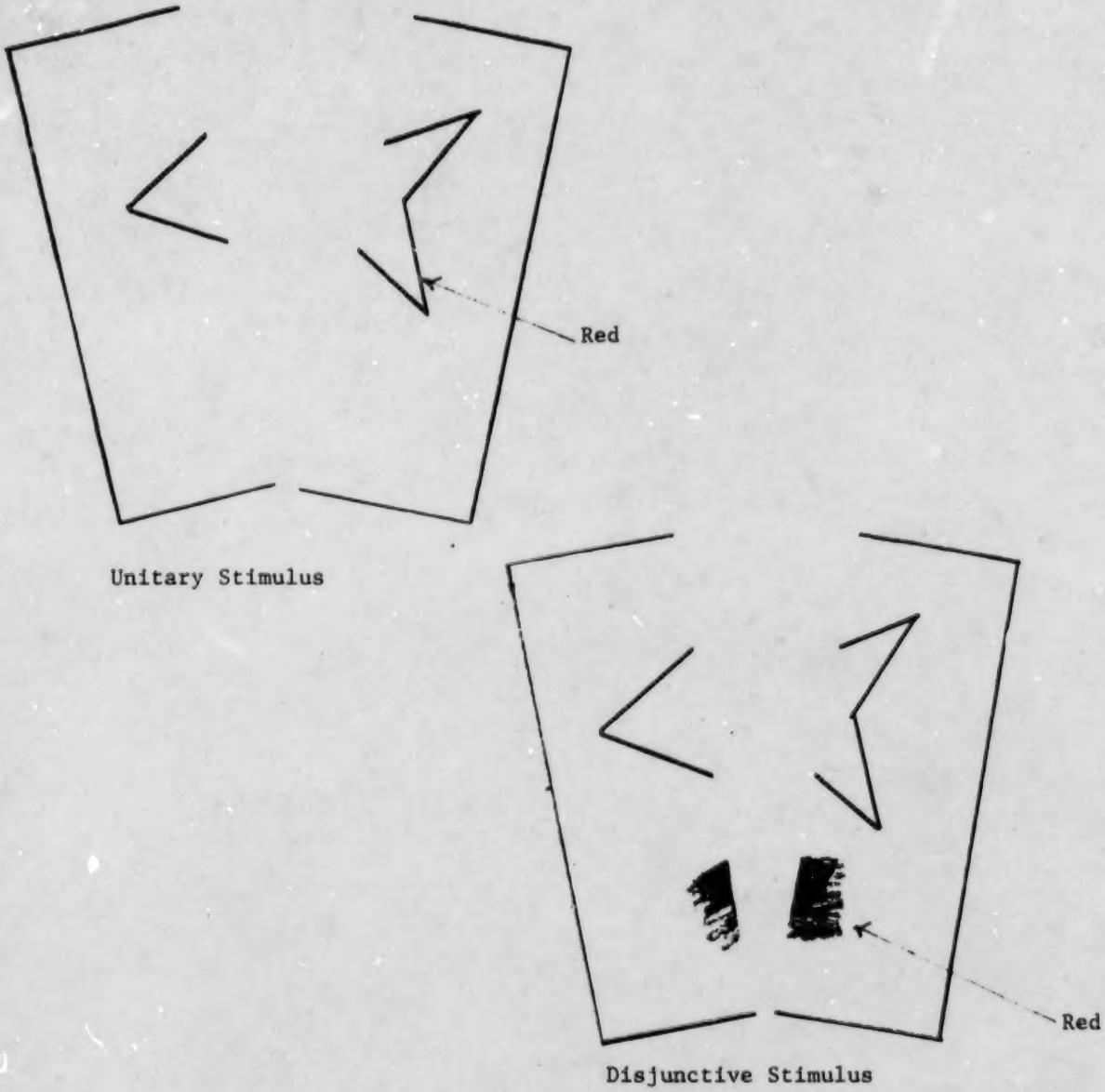


Figure 2. Unitary and Disjunctive Puzzle Stimuli.

Table 1

Mean Number of Correctly Matched

Color-Shape Pairs

	Condition	
Age	Unitary	Disjunctive
5	2.67	1.83
7	3.33	2.5
9	4.6	3.1

N = 72

Table 2

Drawing: Mean Number of Correctly Matched Color-Shape Pairs

	Condition	
Age	Unitary	Disjunctive
5	3.58	1.83
7	5.5	2.8
9	5.9	2.3

N = 72

Table 3

Reconstruction: Mean Number of Correctly Matched Color-Shape Pairs

	Condition	
Age	Unitary	Disjunctive
5	3.67	3.92
7	4.8	4.0
9	6.75	5.58

N = 72

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